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Introduction

Production remains extremely important in our swine industry today. In the past 5-10 years, there has been an increase in the usage of white breeds in swine herds. The white or mother breeds are noted for their increased productivity; however, a question has stirred as to the feeding regime of these productive females. This question is important as feed costs are the major portion of operating expenses for the hog producers. Little controlled research has been conducted in the United States to establish the caloric intake requirement of the white sows during gestation. The National Research Council (NRC, 1979) lists the energy requirement of the bred sow and gilt as 6.1 Mcal of digestible energy (DE) or 5.8 Mcal of metabolizable energy (ME) daily. This recommendation is largely based on research with traditional 3-way crossbred sows. Great Britain swine researchers in the 1960's and United States researchers Frobish and workers (1966) were the last to evaluate the effect of gestation energy on strictly white sows. To help answer the current concerns of white sow nutrition, this research project was designed to study the influence of gestation energy on Large White x Landrace sow productivity.

(Key Words: Sow, Gestation, Metabolizable Energy.)

Experimental Procedure

Two herds (replications) totaling sixty-four Large White x Landrace first litter sows were randomly allotted to two treatment groups stratified by genetic background, pre-breeding weight and breeding date. The treatments were based on two gestation rations supplying metabolizable energy levels of approximately 6.0 or 9.0 Mcal daily. The composition of the experimental diets is shown in table 1. The 6.0 Mcal diet was fed at 4.1 lb daily actually supplying 5.88 Mcal of ME as calculated from NRC (1979) feedstuff energy values. The 9.0 Mcal diet was fed at 6.1 lb daily calculated to actually contain 8.97 Mcal of ME according to NRC (1979) feedstuff energy values. Sows were fed once a day in individual feeding stalls. Water was available ad libitum. The sows remained in the study and on their respective gestation diet four parities if they farrowed, rebred and conceived successfully. These strict criteria were followed to accurately study the effect of gestation energy on sow longevity.

Table 1. Composition of Experimental Diets (%)

Ingredient	Gestation Diet[a] 6.0 Mcal	Gestation Diet[a] 9.0 Mcal	Lactation Diet[b]
Ground corn	79.5	93.9	69.6
Soybean meal, 44%	16.4	3.25	16.1
Ground beet pulp			10.0
Dicalcium phosphate	2.2	1.1	2.55
Ground limestone	1.0	.95	.75
Vit.-TM premix[c]	.5	.5	
Antibiotic, Vit.-TM premix[c,d]			.5
Salt, white	.4	.3	.5
	100.0	100.0	100.0
Feeding rate, lb[e]	4.1	6.1	Ad libitum

a Provided 270.6 g of protein, 16.8 g of calcium and 13.4 g of phosphorus daily.

b From day 110 of gestation, all gilts and sows were fed 4.0 lb of the lactation diet daily. Ad libitum feed consumption was allowed post-farrowing and protein, calcium and phosphorus were supplied at 125% of NRC provided feed consumption was 10 lb/day.

c Vitamins and minerals were supplied at a minimum of 125% of NRC.

d Neoterramycin was added at 66 gm/T.

e Gilts and sows were fed the indicated amounts from breeding until the 110th day of gestation.

First litter sows were allowed access to a self feeder two weeks prior to breeding as a flushing period. Post-weaning sows were fed 5.0 lb of the 6.0 Mcal diet daily. All sows were injected prebreeding with ivermectin and re-treated a year later. They were also injected with a parvo-lepto bacterin at approximately three weeks prior to breeding. The breeding season was restricted to three weeks post-weaning. Sows were hand mated two times a day to unrelated Large White boars for as many services as possible. A boar was then left with serviced females until the end of the three week breeding period.

Gestation housing was concrete floored indoor pens with connecting outside concrete-floored pens. Inside pens were straw bedded according to season demand. The females were moved into the farrowing barn on the 110th day of gestation and were

assigned to concrete floored farrowing crates or pens. Farrowing crate or pen allotments were equally balanced between the two gestation treatments.

The lactation diet was fed at the rate of 4.0 lb daily from the 110th day of gestation to parturation. Following farrowing, the lactation diet was provided ad libitum. At parturation, number of pigs born alive, stillborn and mummified fetuses, as well as total litter and pig weights were recorded. Routine litter management also included clipping of needle teeth, docking of tails, ear notch identification and an im injection of iron dextran. Boar pigs were castrated at 14 days of age. Number of pigs, total litter and pig weights were also recorded at weaning. Pigs were weaned at three-four weeks of age. The oldest litter was weaned at 28 days of age and the litters down to 22 days of age were also weaned. Sow weights were taken at prebreeding, 110 days of gestation, post-farrowing, weaning and rebreeding. Ultrasonic backfat measurements of sows were taken at prebreeding, 110 days of gestation and weaning.

After an eschericha coli scour and TGE outbreak during herd two's first parity, all sows were given a routine escherichia coli bacterin injection three weeks prior to farrowing.

Results and Discussion

The number of experimental observations by herd, parity and treatment are shown in table 2. The largest percentage of sows were removed from herd two after parity one due to sows being slow to return to estrus and not conceiving attributed to a TGE outbreak during the farrowing session. The number of farrowings for the four parities totaled 164 with 83 and 81 farrowings for the 6 Mcal and 9 Mcal groups, respectively.

Table 2. Number of Experimental Observations[a]

	Gestation Treatment				Totals			
	6.0 Mcal		9.0 Mcal		Treatment		Parity	Over-all
Parity	Herd 1	Herd 2	Herd 1	Herd 2	6.0 Mcal	9.0 Mcal		
1	18	14	19	13	32	32	64	
2	15	8	14	8	23	22	45	
3	9	8	10	6	17	16	33	
4	6	5	7	4	11	11	22	
Combined					83	81		164

[a] Sows remained in the study only if they rebred within three weeks postweaning, conceived and farrowed successfully.

The particular gestation months involved are partitioned by herd and parity in table 3. The weather was fairly typical of South Dakota during the respective seasons except December of '83. The temperature was below zero for two weeks straight. Herd 1 was in the last month of gestation and Herd 2 was being bred during this time. The sows did not receive any additional energy source during the persistent sub-zero weather.

Table 3. Gestation Months Involved by Herd and Parity

	Gestation Months	
	Herd 1	Herd 2
Parity 1	September 83-January 84	December 83 - March 84
2	February 84-June 84	April 84-August 84
3	July 84-November 84	September 84-January 85
4	December 84-March 85	Feburary 85-June 85

Pigs were weaned from 22-28 days of age. Table 4 shows the days of lactation for the two treatments and the appropriate parity. The average days of lactation in parity one were low because of the loss of young litters due to the E. coli, TGE outbreak occurring in the middle of the farrowing session. For all parities, days of lactation did not differ statistically between treatment groups.

Table 4. Average Days of Lactation

	Gestation Treatment	
Parity	6.0 Mcal	9.0 Mcal
1	21.8	23.1
2	24.2	25.1
3	23.8	25.2
4	25.5	26.0
Combined	23.8	24.9

Table 5. Parity 1 Sow and Pig Production Data

	Gestation Treatment 6.0 Mcal	9.0 Mcal
	Sow Data	
No. of sows	32	32
Gestation weights:		
Breeding, lb	271.3	269.7
110-day, lb	365.0	378.4
Gestation weight gain, lb *	93.7	108.7
Lactation Weights:		
Post-farrowing, lb	330.4	340.1
Weaning, lb[a]	325.8	342.1
Lactation weight change, lb	- 4.6	2.0
Gestation backfats:		
Breeding, in.	1.16	1.14
110-day, in. **	.87	1.00
Gestation backfat change, in. **	- .29	- .14
Lactation backfats:		
Weaning, in.[a] **	.80	.94
Lactation backfat change, in.	- .07	- .06
Total lactation		
Feed consumption[a] **	322.5	279.2
	Pig Data	
No. of litters	32	32
No. born alive/litter	10.0	9.7
No. of stillbirths/litter	.58	.78
No. of mummies/litter	.00	.09
Total litter birth wt., lb	28.2	28.4
Avg pig birth wt., lb	2.86	2.93
No. alive at weaning/litter	7.5	6.9
Total litter weaning wt., lb[a] *	106.9	91.5
Avg pig weaning wt., lb[a]	12.1	12.0

[a] Weights and backfat are adjusted to a constant day of lactation.

* $P<.05$.

** $P<.01$.

Data for parity 1 is summarized in table 5. Gestation treatment did not affect 110 day sow weights; however, the 9 Mcal sows tended to be heavier at 110 days of gestation and gained more ($P<.05$) weight over the gestation period. The additional energy also significantly affected backfat change during gestation. The 9 Mcal sows lost .14 inches while the 6 Mcal sows lost .29 inches. The extreme cold weather during December of '83 contributed to the backfat losses of both treatment groups. The 9 Mcal sows were more highly conditioned ($P<.01$) by the 110th day of gestation and remained in higher condition through weaning. Lactation weight and backfat measurement changes were not affected by gestation treatment. The lactation weight change is not typical due to herd 2's sows being affected by the TGE outbreak.

The 6 Mcal sows consumed 322.5 lbs of feed during lactation compared to 279.2 lbs for the 9 Mcal sows which differed significantly between treatments. Gestation treatment did not affect number of pigs born alive, stillbirths and mummies per litter or litters and average pig birth weights. Total litter weights at weaning were significantly heavier for the 6 Mcal sows. The 6 Mcal group weaned an average of 7.5 pigs per litter averaging 12.1 lb and similarly the 9 Mcal group weaned on the average 6.9 pigs per litter averaging 12.0 lbs. The low means after birth are because of the loss of pigs due to E. coli scours and TGE.

The data for parity 2 is summarized in table 6. Breeding weights did not differ statistically between treatments; however, at 110 days of lactation the 9 Mcal sows were heavier ($P<.05$) than the 6 Mcal sows. The gestation weight gain was also significantly greater for the 9 Mcal group than the 6 Mcal group (128.3 vs 108.2 lb, respectively). Lactation weights taken post farrowing and weaning did not differ statistically between treatments; however, the 6 Mcal sows gained weight during lactation while the 9 Mcal sows lost weight, a significant difference in lactation weight change.

Sow backfat measurements were greater ($P<.01$) for the 9 Mcal sows than the 6 Mcal sows at the onset of parity 2. This significant difference remained between treatments at 110 days of gestation and weaning. The 9 Mcal sows gained more ($P<.01$) condition during gestation; however, they lost more ($P<.01$) condition during lactation than did the 6 Mcal sows. The additional energy during gestation increased the sow's weight and fat condition but during the period of needed efficient energy utilization the 9 Mcal sows lost weight and condition. Also, during lactation, the 9 Mcal sows consumed 62.7 lb less feed than the 6 Mcal sows. Pig data parameters at birth and weaning were not affected by gestation treatment. Treatment means for number of pigs born alive were 10.6 and 10.8, for litter birth weight were 32.8 and 35.2 lb, for average pig birth weight were 3.19 and 3.32 lb for number weaned were 9.5 and 9.7, for litter weaning weight were 139.0 and 136.2 lb and for average pig weaning weight were 15.2 and 14.4 lb for 6 Mcal and 9 Mcal treatments, respectively.

Table 6. Parity 2 Sow and Pig Production Data

	Gestation Treatment 6.0 Mcal	9.0 Mcal
	Sow Data	
No. of sows	23	22
Gestation weights:		
Breeding, lb	308.0	316.8
110-day, lb*	416.2	444.8
Gestation weight gain, lb *	108.2	128.3
Lactation Weights:		
Post-farrowing, lb	377.5	393.1
Weaning, lb[a]	381.5	378.2
Lactation weight change, lb**	4.0	- 14.9
Gestation backfats:		
Weaning (parity 1), in.[a]**	.79	.94
110-day, in. **	.84	1.14
Gestation backfat change, in. **	.05	.20
Lactation backfats:		
Weaning, in.[a] **	.81	1.03
Lactation backfat change, in.	- .03	- .11
Total lactation		
Feed consumption[a]**	369.4	306.7
	Pig Data	
No. of litters	23	22
No. born alive/litter	10.6	10.8
No. of stillbirths/litter	.35	.59
No. of mummies/litter	.13	.00
Total litter birth wt., lb	32.8	35.2
Avg pig birth wt., lb	3.19	3.32
No. alive at weaning/litter	9.5	9.7
Total litter weaning wt., lb[a]	139.0	136.2
Avg pig weaning wt., lb[a]	15.2	14.4

[a] Weights and backfat are adjusted to a constant day of lactation.

* $P<.05$.

** $P<.01$.

Data for parity 3 is summarized in table 7. Gestation treatments did not affect sow weights or weight changes during gestation and lactation. Gestation and lactation backfat changes also were not significantly different; however, the 9 Mcal sows remained fatter (P<.01) than the 6 Mcal group at 110 days of gestation and weaning. The 6 Mcal sows consumed 60.1 lbs more (P<.01) feed during lactation than the 9 Mcal sow group. Number of pigs, litter weight and average pig weights at birth and weaning were not significantly different due to gestation treatment. Pig numbers at birth were numerically different between treatments; however, there was a large variation within treatments and the difference did not approach level of significance.

Data for parity 4 is summarized in table 8. Sow weights and weight changes were not statistically different between gestation treatments. There was however, a trend for the 9 Mcal sows to be heavier at 110 days of gestation and gain more weight during gestation. The 6 Mcal sows numerically gained 10.1 lbs more during lactation. The 9 Mcal sows were more (P<.05) highly conditioned during gestation but were not statistically different at weaning. However, 9 Mcal sows tended to be still higher conditioned. Feed consumption during lactation was not significantly affected by gestation treatment. Pig data parameters at birth and weaning were not affected by gestation treatments.

Data for all four parities combined is summarized in table 9. Sows were bred at similar weights but by 110 days of gestation the 9 Mcal sows were significantly heavier than the 6 Mcal sows. Although at each parity 110 day weights were not statistically different the trend was for the 9 Mcal sows to be heavier; when parities were combined there was a significant difference. There was also a significant difference in post-farrowing sow weights. The post-farrowing weight difference is due to the 9 Mcal sows being heavier (P<.01) at 110 days of gestation. The weight change from 110 days of gestation to post-farrowing is mainly the parturation weight loss. Each individual parity post-farrowing weights were not statistically different; however, numerically the 9 Mcal sows were heavier and when all parities were combined the gestation treatments had altered post-farrowing weights. Sows were weaned at similar weights. The 6 Mcal sows gained the weight difference during lactation. The weight increase can be attributed to the 6 Mcal sows consuming more (P<.01) feed during lactation. Although the 6 Mcal sows consumed 48.9 lbs more feed during lactation, they consumed 171.1 lbs less feed per parity including both gestation and lactation feed consumption. Backfat measurements remained significantly greater for the 9 Mcal sows at 110 days of gestation and weaning. The 6 Mcal sows farrowed 10.4 pigs live per litter averaging 3.01 lb and similarly the 9 Mcal sows farrowed 10.5 pigs live per litter averaging 3.15 lb. The number of pigs weaned was 8.3 and 8.7 averaging 14.5 and 14.56 lb for 6 Mcal sows and 9 Mcal sows, respectively.

Table 7. Parity 3 Sow and Pig Production Data

	Gestation Treatment 6.0 Mcal	9.0 Mcal
	Sow Data	
No. of sows	17	16
Gestation weights:		
Breeding, lb	351.3	358.8
110-day, lb*	434.7	440.7
Gestation weight gain, lb *	83.4	81.8
Lactation Weights:		
Post-farrowing, lb	406.3	411.0
Weaning, lb[a]	428.3	417.1
Lactation weight change, lb**	22.0	6.1
Gestation backfats:		
Weaning (parity 2), in.[a]**	.80	1.04
110-day, in. **	.76	.98
Gestation backfat change, in. **	- .04	- .06
Lactation backfats:		
Weaning, in.[a] **	.83	.98
Lactation backfat change, in.	.07	.00
Total lactation		
Feed consumption[a]**	409.2	349.1
	Pig Data	
No. of litters	17	16
No. born alive/litter	10.4	10.8
No. of stillbirths/litter	.59	.13
No. of mummies/litter	.00	.00
Total litter birth wt., lb	30.1	33.2
Avg pig birth wt., lb	2.95	3.15
No. alive at weaning/litter	7.3	8.8
Total litter weaning wt., lb[a]	124.7	135.3
Avg pig weaning wt., lb[a]	15.1	15.9

[a] Weights and backfat are adjusted to a constant day of lactation.

* P<.05.

** P<.01.

Table 8. Parity 4 Sow and Pig Production Data

	Gestation Treatment 6.0 Mcal	9.0 Mcal
	Sow Data	
No. of sows	11	11
Gestation weights:		
Breeding, lb	377.3	374.4
110-day, lb*	467.3	497.3
Gestation weight gain, lb	90.0	122.9
Lactation Weights:		
Post-farrowing, lb	427.0	454.9
Weaning, lb[a]	445.3	463.1
Lactation weight change, lb**	18.3	8.2
Gestation backfats:		
Weaning (parity 3), in.[a]*	.81	.95
110-day, in. **	.85	1.02
Gestation backfat change, in.	- .07	- .14
Lactation backfats:		
Weaning, in.[a]	.78	.88
Lactation backfat change, in.	- .07	- .14
Total lactation		
Feed consumption[a]	456.1	426.6
	Pig Data	
No. of litters	11	11
No. born alive/litter	10.5	10.8
No. of stillbirths/litter	1.36	.63
No. of mummies/litter	.08	.07
Total litter birth wt., lb	32.4	34.0
Avg pig birth wt., lb	3.07	3.20
No. alive at weaning/litter	8.9	9.2
Total litter weaning wt., lb[a]	139.8	142.8
Avg pig weaning wt., lb[a]	16.18	15.79

[a] Weights and backfat are adjusted to a constant day of lactation.

* $P<.05$.

** $P<.01$.

Table 9. Combined Parities Sow and Pig Production Data

	Gestation Treatment 6.0 Mcal	9.0 Mcal
	Sow Data	
No. of farrowings	83	81
Gestation weights:		
Breeding, lb	364.6	367.3
110-day, lb**	420.8	440.3
Lactation Weights:		
Post-farrowing, lb*	385.3	399.8
Weaning, lb[a]	395.5	400.5
Gestation backfats:		
110-day, in. **	.93	.97
Lactation backfats:		
Weaning, in.[a] **	.80	.96
Total lactation		
Feed consumption[a] **	389.2	340.3
	Pig Data	
No. of litters	83	81
No. born alive/litter	10.4	10.5
No. of stillbirths/litter	.61	.58
No. of mummies/litter	.04	.04
Total litter birth wt., lb	30.9	32.7
Avg pig birth wt., lb	3.01	3.15
No. alive at weaning/litter	8.3	8.7
Total litter weaning wt., lb[a]	126.9	125.8
Avg pig weaning wt., lb[a]	14.50	14.56

[a] Weights and backfat are adjusted to a constant day of lactation.

* P<.05.

** P<.01.

Gestation energy treatments altered sow gestation and lactation weights and backfat measurements but there was no advantage in pig performance due to feeding 4.1 or 6.1 lb during gestation.

Days to return to estrus for all four parities and combined parities are shown in table 10. Gestation treatment did not significantly affect days to return to estrus post-weaning for any parity or combined parities. Days to return to estrus for parity one were extended in comparison to parities two, three and four due to the TGE effect on herd two sows.

Table 11 shows the reasons the sows were removed from the experiment and at what point they were removed. Gestation treatment did not seem to affect the reason or time the sows were taken out of the experiment. The 6 Mcal treatment had 21 sows eliminated due to failure to return to estrus (7), failure to conceive (12) and two were lost due to being placed in the incorrect treatment post-breeding. Twenty-one 9 Mcal treatment sows were removed from the experiment due to failure to return to estrus (6), failure to conceive (13), one died and one was lame when she came into the barn at 110 days of gestation. The lame sow farrowed and lactated successfully, however, was not able to be bred due to unsoundness.

Table 10. Days to Return to Estrus Post-weaning (Parity 1, 2, 3 and combined)

	Gestation Treatment	
Parity	6.0 Mcal	9.0 Mcal
1	9.4	9.6
2	5.0	5.5
3	5.4	5.3
4	6.0	6.2
Combined	6.4	6.7

Table 11. Reasons for Leaving the Experiment

Gestation Treatment	Parity 1-2		Parity 2-3		Parity 3-4		Combined	
	6 Mcal	9 Mcal	6 Mcal	9 Mcal	6 Mcal	9 Mcal	6 Mcal	9 Mcal
Failed to return to estrus	3	4	1	1	3	1	7	6
Failed to conceive	6	6	4	3	2	4	12	13
Died[a]				1				1
Lame				1				1
Other[b]			1		1		2	
Treatment Totals	9	10	6	6	6	5	21	21

a Death was not due to treatment.

b Sows were placed into the incorrect treatment group after breeding.

Summary

Sixty-four Large White x Landrace sows were alloted to two gestation treatments of 6 and 9 Mcal of ME daily. The sows were maintained in the study on their respective treatments for four consecutive farrowings if they farrowed successfully, rebred and conceived post-weaning. Gestation energy altered sow gestation and lactation weights and backfat measurements but did not alter litter performance, days to return to estrus or the time and reason a sow was removed from the study. Based on these results, the current NRC energy recommendation is adequate for productive Large White, Landrace F females.